MECHANICS' MAGAZINE,

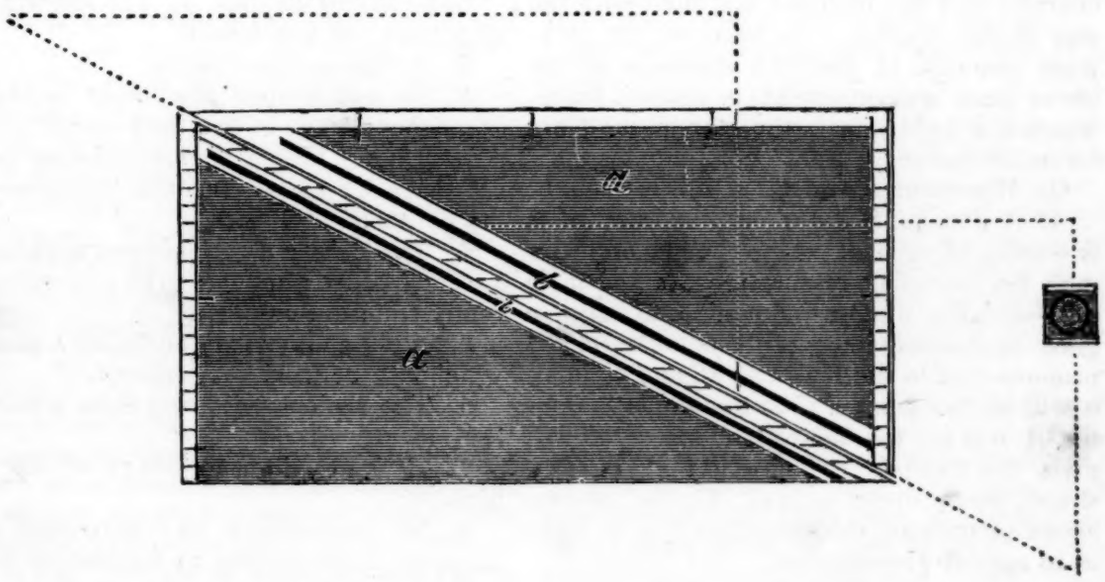
AND

REGISTER OF INVENTIONS AND IMPROVEMENTS.

VOLUME IV.] FOR THE WEEK ENDING JULY 12, 1834. [NUMBER 1.

"It is in the animal body that true perfection and the greatest variety of mechanism are found. Where to illustrate *Mechanics*, is to be found a system of levers and hinges, and moving parts, like the limbs of an animal body; where such an *hydraulic* apparatus as in the heart and blood vessels; such a *pneumatic*, as in the breathing chest; such *acoustic* instruments as in the ear and larynx; such an *optical* instrument, as in the eye;—in a word, such variety and perfection as in the whole of the visible anatomy?"—DR. ARNOTT.

PARALLEL RULING MACHINE.



Newly Invented Parallel Ruler for Making of Horizontal and Parallel Lines. [Communicated for the Mechanics' Magazine and Register of Inventions and Improvements.]

To the Editor of the Mechanics' Magazine:

DEAR SIR,—I send you the sketch of a Parallel Ruler executed under my direction by Ewin & Heartte, of this place, to whom I give the patent right, if they choose to take it.

You will see that the great desideratum of a true parallel ruler for horizontal as well as for perpendicular lines is now accomplished; and that in changing the edges in scales differently divided, engineers and architects will save half of the time in the construction and measurement of their drafts.

References—*a*, common triangles in mahogany or box wood; *b*, groove in brass; *c*, connecting sliding string. The dotted lines show the motion of the upper triangle.

Yours sincerely,

B. PETITVAL, Civil Engineer.

A Compendium of Civil Architecture, arranged in Questions and Answers, with Notes, embracing History, the Classics, and the Early Arts, &c. By ROBERT BRINDLEY, Architect, Surveyor, and Engineer. [Continued from vol. iii., page 330.]

COMPOSED ORDERS.

Q. What are composed orders?

A. Specimens of architecture, (even to be met with in Greece and Rome,) whose proportions and composition do not agree with any of the fine orders.

Q. How are they comprised?

A. Under the general name of *Composed orders;* and, though beautiful as small works, scarcely any of the ancient ones are worthy of imitation in large buildings; and modern composition has afforded but few specimens.

Q. What attempt has been made in England to introduce a new order of architecture?

A. A most singular one, some years since, at Windsor, by Mr. Emelyn, an architect who conducted the restoration of St. George's

chapel. He published a magnificent treatise on the subject, and executed one portico and a few door-cases in and near Windsor.

Q. What are the peculiarities of this novel order?*

A. Mr. Emelyn says, "his order was first brought into his mind by the twin trees in Windsor forest? He makes an oval shaft rise one fourth of its height, and then two round shafts spring from it, close to each other; and the diminution affords space for two capitals, which have volutes, and, instead of leaves, feathers, like the cap of the Knights of the Garter. The entablature has triglyphs, and the cornice mutules. The triglyphs are ostrich feathers; the guttæ acorns; and the metopes are filled with the star of the Garter. To conceal the awkward junction of the two columns to the lower part, an ornament is placed there, which is a trophy, with the star of the Garter in the centre.

Q. What was the result of this attempt?

A. A decided failure; but nevertheless it is worthy of record. This species of order must be extremely unmanageable and difficult—indeed, almost impossible to make a good angle column. If its entablature be proportioned to the diameter of one column, it will be too small; if to the whole diameter, it will be too heavy; and a mean will give the capitals wrong—so that, in any shape, some error arises. In the portico above-mentioned, the entablature is so light as to appear preposterous.

THE DISTINGUISHING PRINCIPLES OF ENGLISH STYLES, AND GRECIAN AND ROMAN ORDERS.

Q. What are the striking contrasts of the English styles, and Grecian and Roman orders?

A. They are formed by those principles, in buildings of real purity, which will at once demonstrate the impossibility of a good mixture.

Q. Enumerate the comparisons?

A. *English.* 1. The general running lines are perpendicular.

2. Arches, a real fundamental principle; and no pure English building or ornament can be composed without them.

3. No such thing as entablature composed of parts; and what is called a cornice bears no real relation to the shafts which may be in the same building.

4. The shafts can only support an arched moulding, and in no case a horizontal line.

5. Nothing analogous to a pilaster; every flat ornamented projecting surface is either a series of panels or a buttress.

6. No horizontal line necessary; and never any but the small cap of a shaft.

7. Shaft bears nothing, and is only ornamental; and the round pier still a pier.

8. Buttresses essential parts, and stop all horizontal lines.

9. Pediment only an ornamented end wall, and may be almost of any pitch.

10. Openings almost unlimited.

11. Regularity of composition seldom found; and variety of ornament universal.

12. From its perpendicular lines may be carried to any practicable height, with almost increasing beauty.

Grecian and Roman. 1. The several running lines are horizontal.

2. Arches not necessary.

3. An entablature absolutely necessary, consisting always of two, and mostly of three distinct parts, having a close relation to, and its character and ornaments determined by, the columns.

4. The columns can support nothing but an entablature; and no arch can spring directly from the column.

5. A flat column may be called a pilaster; which can be used as a column.

6. The arch must spring from a horizontal line.

7. Columns, the supporters of the entablature.

8. No projections like buttresses; and all projections stopped by horizontal lines.

9. Arrangement of pediment fixed.

10. Openings limited by the proportion of the columns.

11. Regularity of composition on each side of a centre necessary.

12. Cannot form good steeples, because they must resemble unconnected buildings piled on each other.

NOTE.—Vanburg (1700) had a style of architecture peculiar to his own views—the Clarendon Printing Office, at Oxford, the buildings in the Gunwharf at Devonport, and other Government erections, pourtray such sombre appearance and massive construction, that the following lines are said to be inscribed on his monumental tablet:

"Lie heavy on him, earth, for he
Laid many a heavy load on thee."

It must be observed, in modern buildings, that, deviating from the prescriptive styles and orders just noticed, a species of *Italian architecture* is introduced in our villas and country residences, conspicuous by the several verandas round the dwellings, forming balconies, colonnades, &c. whilst the windows in some instances are hung with Venetian shades, giving a *tout-en-semble* appearance of neatness and pleasantness. Another mode of building is very appropriately designated *Rustic Architecture*, in which the roofs are thatched with straw or reeds, the trunks of unhewn elms or oaks supporting their projections, or forming porches, and the ivy, with the jessamine and the honeysuckle, in their season, diffusing sweet odors around the delightful spot.

* This attempt is not generally known, as the book was very expensive, and the portico at a distance from the public road.

ANTIQUE AND MODERN EUROPEAN BUILDINGS.

Q. What are the principal works of the Grecians, extant; or whose ruins declare the mighty power of genius that reigned in that once astonishing empire?

A. The Parthenon, a temple at Athens, sacred to Minerva, destroyed by the Persians, and afterwards rebuilt by Pericles, in a more magnificent manner. It is an oblong parallelogram, adorned with a vestibule, a *pronaos* or portico, and raised upon three steps, all round; the interior was divided into two distinct naves, receiving all their light from the door; in one was the statue of Minerva, twenty-six cubits high, made of gold and ivory, the work of Phidias; in the other was the treasure of the Athenians. The columns of the vestibule and portico (fluted) rested on the steps of the temple, without bases, and were forty-two feet high, seven diameters and a half at bottom; intercolumniation, seven diameters and a quarter. The whole structure was two hundred and eighteen feet long, and ninety-eight feet and a half broad. The frieze was decorated with triglyphs and metopes of marble sculptured between, and the pediment grouped; the frieze of the *cella* was decorated in *basso relievo*. The building being of marble, with a brilliant sun shining on its walls and columns, produced a golden tint, and added to the glory of Grecian architectural specimens. The temples of Theseus, at Athens, and Jupiter Panhellenicus, at Ægina, are still extant in fallen ruins.

Q. Was Grecian architecture adopted in other countries?

A. Yes; in Sicily, and South of Italy. The magnificent ruins of the temple of Juno, at Agrigentum, the temples and porticos at Pæstum, south of Naples, the excavations of Pompeii, and the ruins of Palmyra, in the east of Syria, consisting of porticos, temples, and palaces, declare the mighty sway of Grecian art and Grecian prowess.

Q. What mementi have the Romans left the world of their great achievements in architecture?

A. Numerous: Rome, in her prosperity, having no less than four hundred and twenty temples, most of which were circular, crowned with domes, and crowded with statues. Amongst the most famous of temples were those of Romulus, Janus, Cybele, Vesta, Mars, the Sybils, Jupiter Tonans at the foot of the capitol, Vespasian's Temple of Peace, and that of Jupiter Stator, in the Forum. The Forums were several; but the Roman forum, the most renowned spot of the ancient city, exceeded all the rest in size, splendor, and architectural beauty; of the others, that of Trajan occupies a priority of rank, with Trajan's column in front; nor must be omitted, the Coliseum, Circus, and Amphitheatre, at Verona—the Amphitheatre at Pola (the front pillars being of the Corinthian order)—the Theatre of Marcellus—the Pantheon, built by Agrippa, A. D. 8, or 10, over whose immense area is thrown the pensile vault, and is now converted into a Christian temple—the triumphal arches of Severus, Titus, Constantine—the pillar of Antonius—finally, the tomb of Hadrian, now the castle of St. Angelo—the stupendous aqueducts—the noble bridges, fountains, catacombs, and obelisks—with superior specimens of tesselated pavement.*

Q. What have been the most remarkable buildings amongst the Christian nations?

A. Churches began to be erected in great splendor after Constantine made Christianity the religion of the Roman empire. St. Helena, the mother of Constantine, built many churches in Palestine.

Q. Which are the greatest productions?

A. Of Grecian art, the largest and most magnificent church is that of St. Sophia, or the church of Divine wisdom, at Constantinople, which is now used by the Turks as a mosque.

Q. Which is the most magnificent pile of architecture in the world?

A. The Church of St. Peter, at Rome; the area of whose floor contains about four times the space of St. Paul's, at London, being eight hundred and forty feet long, seven hundred and twenty-five feet broad, three hundred feet high, and two thousand four hundred and sixty-five feet in circumference. It took 150 years to build; and its splendor well accords with the enormous sum said to have been expended—£12,000,000.

Q. What other Romish church deserves particular attention?

A. The Cathedral Church of Milan, a building of great magnitude and beauty, of the pointed style, and adorned with 11,000 figures. The Milanese call this fabric the *Eighth Wonder of the World*. It is 500 feet long, 200 feet broad, and 400 feet high. At Milan also are several fine palaces, churches, convents, and schools.

Q. What are the antiquities of Spain?

A. They are principally of the Roman and Moorish; amongst which will be found

* Rome has, at present, (though only one fourth its former size,) three hundred towers, as many churches, twenty-eight gates, and six bridges over the Tiber. The Library of the Vatican, the Pope's Palaces, namely, the *Vatican*, a *Summer-house* on Mount *Cavillo*, and the Palaces of the Vatican near the church of St. John, where they crown the Popes, deserve particular notice.

the Cathedral of Seville, the Royal Palace (Alcazar) built by the Moors, also an aqueduct six miles in length. Burgos, the capital of Old Castile, is noted for its Cathedral —being one of the most magnificent religious fabrics in Europe. Salamanca boasts of its University, magnificent churches, and fine fountains; the Cathedral is of beautiful structure; over the river Tormes, passing through Salamanca, is a bridge, built by the Romans; near the city also are the remains of a *Roman Way*, paved with large flat stones—it was continued to Merida, and from thence to Seville. Badajoz is also famous for a Roman bridge, over the Guadiana; also Alcantura, for one over the Tajo, built by Trajan, the Roman emperor. Alcala stands high for its University, built by Ximenes. Near Segovia is a grand aqueduct, supposed to have been erected by Trajan: it extends over a deep valley, and is supported by a double row of one hundred and fifty-nine arches. At Toledo are the remains of an old Roman theatre, now converted into a church. It is six hundred feet broad, and of proportionable height: the roof is very bold and lofty, supported by three hundred and fifty pillars of the finest marble. Martorel has a lofty bridge, built in 1768, out of the ruins of an old one that had existed 1015 years from its erection by Hannibal: at the north end is a triumphal arch, almost entire, raised by Hannibal, in honor of his father, Hamilcar. The fortified palace of Alhambra, in Grenada, was built in 1280 by the second Moorish king of Grenada, and in the reign of the eighteenth king, in 1492, was taken by the Spaniards. The beautiful gate called Alcala, at the entrance of Madrid, together with the variety of steeples and spires, give this city great dignity of appearance. The Escurial, in New Castile, is esteemed the most costly palace in Europe.

Q. What are the edifices throughout France claiming notice?

A. In Paris are the Palaces (very superb buildings) of the Tuileries and Louvre, the Palais Royal, Palais Bourbon, or French House of Commons, Palace of the Luxemburg, or Chamber of Peers, Palais du Temple, Palais de Justice, and Palais de Thermes, (of Roman antiquity,) with numerous others. Hotel Royal des Invalids, Hotel de la Legion d'Honneur, Hotel des Gardes du Corps, with many more Hotels. The churches are those of Notre Dame, St. Genevieve, (or Pantheon,) and several of minor construction. Theatres, barracks, triumphal arches, as St. Denis, St. Martin, and L'Etoile, and Column in the Place Vendome, the Pont de Neuf, and piles of other buildings in and near Paris, partaking of different styles and orders, render this metropolis a second Rome. The Cathedral of Rouen is one of the most magnificent monuments of pointed architecture in the world: it was built under William the Conqueror's reign, and completed in 1063. Strasburg, near the Rhine, is noted for its lofty spire, the highest in Europe, being five hundred and seventy-four feet; that of Salisbury, in Wiltshire, four hundred and ten.

Q. What are the antiquities of Portugal?

A. Roman and Moorish. The Roman bridge and aqueduct at Coimbra are almost entire. The walls of Santarem are likewise of Roman origin. Near Braga are the remains of a temple, supposed to have been dedicated to Æsculapius. The remains of the Moorish Castle at Torres Vedras claim particular notice.

Q. What is to be advanced on the antiquities and buildings of Switzerland?

A. Basle, or Basil, possesses a beautiful cathedral. Lausanne has a fine church, in which is the Tomb of Amadeus VIII. Duke of Savoy. Here also is a University, founded in 1360. Lucerne is remarkable for its bridges, being covered at the top, and open in the sides, and decorated with coarse paintings; amongst which are the histories of the Old Testament, the battles of the Swiss, and the Dance of Death. St. Gallen has a rich and celebrated Abbey, in which were found, in 1413, several manuscripts of the classic writers, Petronius Arbiter, Valerius Flaccus, and Quintilian. In Switzerland are several hermitages of peculiar construction: the most curious is one six miles from Friburg, amongst woods and rocks; it consists of a chapel, an oratory, (a place for praying,) steeple, hall, kitchen, rooms, stairs, well, and other conveniences, all hewn out of a rock, even to the chimney and steeple; though the latter is 54 feet high—*the labor only of one man and a boy.*

Q. What other continental nations deserve notice for their several buildings?

A. Those of Germany deserve attention, particularly the churches at Hamburg; Berlin is considered one of the handsomest cities in Europe; Koningsburg has a large University, a magnificent palace, and a handsome library; Vienna is adorned with several splendid public edifices. The Stadthouse, Amsterdam, founded on piles, as also the city itself, extending over eighty-two islands, which communicate with each other by three hundred bridges; Rotterdam possesses fine buildings, in cathedrals, churches, &c.; Antwerp has beautiful churches, and a noble

exchange, from which Sir Thomas Gresham took the model of that in London; Leyden and Utrecht are noted for their Universities; the Hague, as the seat of Government, is greatly celebrated for the magnificence and beauty of its buildings; and Haarlem is remarkable for its cathedral, and the finest organ in Europe, consisting of eight thousand pipes—the largest is thirty eight feet long, and sixteen inches diameter; Ghent abounds in churches and monasteries; as also Leige, Luxemburg, and Bruges. Upsal, in Norway, is noted for its University. Moscow is a city of particular splendor; of which, it has been observed, "here are seen grouped together, spires glittering with gold amidst burnished domes and painted palaces, mixed with pagodas from China, mosques from Constantinople, Tartar temples from Bucharia, and cabarets from Spain." St. Petersburgh, with its imperial palaces and lofty towers, vies with the ancient city.

Q. What are the antiquities and buildings in England, claiming particular attention?

A. In London the most remarkable is St. Paul's, whose length within the walls is five hundred feet, and its height three hundred and forty feet. It is built of Portland stone, after the model of St. Peter's, at Rome; it is the principal work of Sir C. Wren, who finished the building thirty-seven years after he had laid the foundation stone, being begun in 1673 and finished in 1710. Westminster Abbey claims the next rank to St. Paul's, being a superior edifice of pointed architecture. Mention is made of this building as early as the year 850; it was rebuilt by Edgar, and again by Edward the Confessor. Westminster Hall is said to be the largest room in the world, being two hundred and thirty feet in length, and seventy-six in breadth: it has a beautiful pendant roof. The tower is of great antiquity, (supposed to have been built by William the Conqueror,) containing many curiosities, and subsequently the occasional residences of princes. The Guildhall claims attention, under whose roof the civic feast is well displayed. The Monument is a beautiful structure, two hundred and two feet high, and fifteen feet in diameter: it was built in 1671. The Royal Exchange, erected by Parliament, in 1669, after the one destroyed, built by Sir T. Gresham—the British Museum, containing many curiosities—Somerset House, built by the Duke of Somerset—the Mint—the Bank—the Coliseum—the Custom House—the Post Office—the Parliament House—the King's Palace—the Triumphal Arches at the western entrance of the city—the several bridges, namely, London, Westminster, Blackfriars, Waterloo, Southwark, and Vauxhall, (the two last built of iron); with which must be enumerated the several churches and chapels, both antique and modern—with modern terraces, crescents, villas, &c.: all claiming attention as adding a lustre to a British metropolis.

Q. What are the other buildings throughout England?

A. York Minster, the Cathedrals of Canterbury, Durham, Worcester, Lincoln, Exeter, Winchester, Gloucester, Norwich, Chester, Rochester, Wells, Litchfield, Salisbury—all partaking more or less, excepting the last, in the several repairs afforded, of the Saxon, the Norman, and the English styles of Architecture; nor must be omitted the two Universities of Oxford and Cambridge, whose Colleges and Halls vary in design from the Saxon, through successive ages down to the Grecian and Roman. Eton College stands high; as also Greenwich Hospital; but, above all, the princely residence of kings, Windsor Castle. The Pavilion at Brighton is splendid, though peculiar. In our principal towns, as Liverpool, Bath, Bristol, &c. and the lordly domains throughout the country, are great displays of superior modern architecture.

Q. What are the antiquities of Great Britain?

A. Of British antiquities, Stonehenge, in Wiltshire, is the chief, consisting of two circular and two oval ranges of rough stones, having one common centre; the circle is one hundred and eight feet diameter. Many of these Druidical temples are to be found round about the country, particularly in Wales, called by the inhabitants Cromlechen. Roman and British camps, walls, castles, &c. abound here. Of Roman, the Picts' Wall claims priority; it began at the entrance of Solway Frith, in Cumberland, running by Carlisle, and Newcastle, and ended at Tynemouth. It was first built of earth by the Emperor Adrian, in 123, and afterwards of stone, by the Emperor Severus; Ætius, a Roman general, rebuilt it of bricks in 430. It was eight feet thick, twelve feet high, and about one hundred miles in length. Next are the *military ways*—their vestiges are numerous in the kingdom. One of these ways extended from Dover to London, from thence through Verulam, &c. to near Shrewsbury, and thence through the middle of Wales to Cardigan. The *Herman street*, or *Great Military Way*, passed from London through Lincoln, &c., the *causeway* of which is perfect in many places, although finished nearly one thousand six hundred years since. Of Saxon, Danish, and Norman antiquities,

they consist principally in cathedrals, castles, (Rochester,) and various camps.

Q. What are the claims of Scotland in antiquities and buildings?

A. Edinburgh, the capital, is peculiar in its buildings, remarkable for the loftiness of its houses, inhabited on different floors by distinct families; it contains the Palace of Holyrood, the Castle, and several elegant churches and buildings. Edinburgh, Glasgow, St. Andrews, and Aberdeen, are noted for their Universities. Granite, free-stone, lime-stone, marble, and slate, being found in Scotland in great abundance, contribute to the grandeur of the several buildings.

Q. What is to be advanced about Ireland?

A. Dublin, its metropolis, is characterised for fine specimens of architecture in its Post Office, University, Theatre, and other buildings, and ranks as the second city in the British dominions.

PRACTICAL ARCHITECTURE.

Q. Whence is the word architect derived?

A. From the Greek word *arche*, chief, and *teucho*, to form—in the Latin, rendered *architectus*,—both equally significant; it implies the principal deviser, contriver, or inventor of any thing. Hence, "Deus regnator architectus omnibus"—ascribing the appellation to the Deity itself.

Q. What is architecture, then?

A. It is the production of power, of might, of skill—displaying the co-operation of mental energy and physical power, founded on the nicest mathematical principles.

Q. What are these principles?

A. Order, disposition, and proportion, established on the grand basis of *solidity*.

Q. What is implied by solidity?

A. Strength, firmness, massiveness—in opposition to superficials. Thus, when Cicero says, "atomorum soliditas," defines, that there may be even solidity in an atom.

Q. Where is solidity sought?

A. For the *foundations of all superstructures*.

Q. How are foundations considered?

A. The earth producing different soils and strata, foundations become natural or artificial.

Q. What are natural foundations?

A. Where the ground is good or rocky, as on the western shores of England.

Q. What are artificial foundations?

A. When, from the boggy or sandy state, piling, arching, or some other precaution, must be resorted to, before the fabric can be reared.

Q. What is the first essay to be made for building?

A. The knowledge of the properties of the ground, by boring; should it shake on being struck with the rammer, excavation may be commenced, widening at the top; and instead of inclined sides, it is preferable to cut steps, by which means a firmer bed will be obtained for the wall.

Q. What directions for foundations does Palladio recommend?

A. That the ground be dug to one sixth part of the whole height of the building, unless there be cellars, when he recommends going deeper. This, however, the practitioner can appreciate; but it is a good rule to make the foundation double the breadth intended for the superincumbent wall; and the contraction of it should be made alike on both sides. The foundations of St. Paul's and the Monument are extremely deep.

Q. When the ground is found defective in one place, and good in another, to prevent an unequal settlement of the building what method is resorted to?

A. The use of arches, either inverted or suspended, according to circumstances.

Q. When are inverted arches used?

A. When the soft parts of the ground are under the apertures only.

Q. Of what advantage is this method?

A. That one continued base is obtained; for the piers cannot sink without carrying the arches, and consequently the ground upon which they stand along with them. The whole building will therefore sink equally, and no fracture of the walls ensue. Inverted arches are frequently used, even on good foundations; they are particularly applicable to small bridges over canals, in indifferent ground, and should be thrown with the greatest care, closely jointed, and their depth equal to half their width.

Q. When are suspended arches used?

A. On the reverse of the preceding occurring: *i. e.* when solid foundations are only to be found under apertures, then piers must be built in their places, and arches suspended between them.

Q. What is the determination on this point?

A. That it is best to make the middle of the pier rest upon the middle of the summit of the arches. If the pier do not cover the arch, the narrower it is the greater should be the curvature of the latter at the apex. When arches are used in this way, the *intrados* ought to be clear, that they may have their full effect. The uniform resistance of the ground upon which the piers are erected is also of greater importance than even its perfect hardness; for, if it resist uniformly, the building will sink in every part alike, and remain uninjured: this custom is adopted where the wall is carried to

a great height, and the levels filled up, as exemplified in the boundary walls of the House of Correction, Clerkenwell, London.

Q. What is the importance consequent on the foundations and abutments of bridges?

A. The foundations and abutments have not merely the superstructure to bear, but the flux and re-flux of tides to oppose, and the test of ages, with all their concomitants, upon the materials used, to endure.

Q. What does Palladio observe on bridges?

A. "To make bridges lasting, the goodness of the ground is one of the most important things to be attended to. Bridges ought always to be constructed at right angles with the current—the piers so proportioned as to enable them to withstand the thrust of the adjoining arches, though the rest were thrown down; yet to fall short of the size required for this purpose, would hardly be a greater fault than materially to exceed it; for when the piers are unnecessarily larger, the current, being contracted, increases its velocity, and is apt to undermine the foundation."

Q. How are the foundations of the piers of bridges effected?

A. By a *caisson*, an immense vessel of peculiar construction, which is sunken where the foundations are determined, and being hollow, the water is pumped out and the work begun—or by driving piles closely together, forming a *coffer dam*, secured by cross pieces, braces, bolts, &c.; it is then caulked or clayed as the water recedes, and the remainder is pumped out.

Q. What are the preparatory measures adopted for the foundations?

A. Dry straight-grained piles of elm or beech of certain lengths, shoed and capped with iron, are driven by engines constructed for the purpose. When this area of piles is completed, with as even surface as possible, *sleepers* of the same wood are spiked to their heads: three, four, or five courses of good bricks, bedded in a composition of lime, pozzolona, and clean sand, are then laid, and upon this work the stones of the intended superstructure are placed. Hence the artificial foundations of bridges. Of such foundations also are the dry docks of His Majesty's yards—of dock-walls, contiguous to the river, particularly the external wall to the basin, and the basin itself, at Sheerness Yard. Nor must be forgotten the Stadthouse, or palace, in the Netherlands, founded upon piles, at a most enormous expense.

Q. What foundation particularly claims attention?

A. It is that of the Eddystone Light-house—being natural: the base of this solitary pile, which consists of solid stones, is united to the surface of the rock by dove-tailing and cramping; which surface, being inclined, is cut away—forming steps for the preceding purpose. The building is carried up (nearly solid) to a great height, having merely a well to communicate to the upper chambers, whose stone floors are arched, and meet the pressure of the exterior walls. Chains are let into the several stones, and leaded. The whole of the work is executed with the nicest precision, and stands, amidst the tempest's rage, a master-piece of art. The Rock Light-house, off Ireland, is built upon similar construction.

Q. What gigantic mole rises to the furies of the Atlantic?

A. The Breakwater, at Plymouth; this mole extends itself across the Sound, from east to west, nearly a mile—the extreme ends running obtusely from the inner parallel line to a certain extent: it consists of some thousands of tons of marble blocks, varying from five to fifteen tons, brought from the neighboring quarries by vessels, and deposited in line, forming a wide bed at the bottom, diminishng at the top to high-water mark. The surface of this extraordinary foundation is neatly laid with the blocks, forming a pavement. It is proposed on this mole to erect two light-houses—one at each extremity. The object of the breakwater, as its name imports, is to break off the fury of the sea, and afford good anchorage and shelter to shipping.

Q. What is to be said of the sub-marine foundation of the Tunnel under the Thames?

A. This, perhaps, is one of the most extraordinary attempts in history: from a shaft sunk in the Rotherhithe side, half the work is accomplished in a direct line under the Thames. The figure of the tunnel is an ellipsis, with a division wall in the centre, concentrating the figure into two ellipses, affording passages for ingress and egress. The whole is executed in brick-work of six or seven courses in thickness. The work was carried on by a machine which was moved progressively forward with the masons and excavators, as the excavation proceeded.

Q. Is there any other description of tunnels?

A. Yes, several; a fine specimen of tunnelling is to be found in the Thames and Medway Tunnel, extending two miles and a half in length, uniting these rivers. This tunnel is excavated under a range of chalk hills; the arch is pointed, the crowns of the extremities being only secured with brick about three hundred yards in, the natural qualities of the chalk requiring no continuation of brick arching, excepting where the shafts are introduced. Barges constantly

pass to and fro, in five feet water—with a horse-path on one side. The base of the tunnel is square, on solid chalk.

Q. What are aqueducts?

A. Artificial channels of water, connecting canals together, over a valley, or even over rivers. They are constructed upon the principles of bridge building, having piers and arches to support the column of water passing over; stout breast-work is carried up on either side, as the parapet of a bridge, leaving a path-way on one side. There are several in England, but of no great moment.

NOTE.—This description of the several foundations appears more properly to belong to the branch of Civil Engineering; but in many instances the duties of Engineers and Architects run into each other, and become so reciprocal, that it is quite admissible.

T. Ewbank's Hydrostatic Safety Valve and Gauge, for Steam Boilers. [Communicated by the Inventor.]

SIR,—In accordance with your request, I forward a brief description of the Hydrostatic Safety Valve, premising that a more perfect account of it may be seen in the "Journal of the Franklin Institute" for January and July of last year, (vols. 9 and 10.)

There appears to be a prevailing though erroneous opinion, that steam boilers are seldom, if ever, exploded by an excessive pressure of steam. Numerous persons suppose these disasters to be *invariably* owing to a deficiency of water within them at the time; hence they consider all improvements in the safety valve, or the application of other devices for a similar purpose, as having a tendency to increase the risk of explosion, by promoting negligence in the attendants. It is sufficient to observe, in answer to reasoning of this description, that it is equally calculated to prevent all improvements whatever in the steam engine. Had such arguments been listened to 120 years ago, this noble prime mover of the arts might still have been confined to its original purpose of raising water; and each one attended by a person, upon whose attention in alternately opening and closing the valves, the continuance of its motion depended. Such objections were particularly calculated to prevent the introduction of the important improvement of Potter, who, it is said, had a disposition to skulk, or "*scog*," (as it was there termed,) which led him to devise a simple contrivance, which changed the whole character of the steam engine—for by it the engine no longer depended upon an attendant for the continuance of its motion, but became in a manner self-acting, and with a regularity infinitely superior to its previous movements. His device he called a "scogger."

Explosions of steam boilers are not attributable to *one* cause: there are several. A deficiency of water is a fruitful one; excessive pressure of steam is another; a third may be found in the defective construction of a boiler; and where several are connected together, their not being *heated uniformly* is another. Numerous examples of each of these might readily be furnished. I believe there are not wanting instances where the attending engineers have been blamed, when the real cause was to be found in one or both of those last mentioned.

The importance of the safety valve is universally understood; without it no boiler could ever be secure. Upon it depends the very existence of the steam engine; for without the safety valve, as Mr. Galloway justly observes, "steam would, long ere this, have been abandoned as a most dangerous and ungovernable agent." Every person can readily perceive, that however strong a boiler may be, if the force within it be not limited it must be rent asunder; hence the design of safety valves, which are intended to open, and discharge the excess of vapor, whenever its elastic force exceeds the prescribed limits. In the case of a steamboat, the lives of the passengers and safety of the boat depend in a great measure upon the right construction and proper use of this part of the steam engine.

One of its most essential attributes consists in its being properly loaded; and a provision to prevent this load from being increased. By the arrangement of the ordinary valve, it is difficult, if not impossible, to accomplish this; the load *may* be increased indefinitely, either by augmenting the weight directly on the lever, or by moving it further from the fulcrum: how frequently and fatally this has been done, may be abundantly seen in the history of explosions. There are also other defects in the ordinary valve, though less obvious to common observers, such as the indirect mode of obtaining the pressure upon it, through the intervention of the lever and its joints, by which the centre of pressure, instead of being directly on the centre of the valve, becomes more or less on one side, which prevents it from being raised perpendicularly, and causes it to adhere to its seat. The friction of the stuffing-box, through which the valve rod passes, and also that of the joints, both of it and the lever, which from rust, &c. is often considerable. These and other defects are so great, that were it not for the mercurial gauges used with low pressure

boilers, (and they are inapplicable to those of high pressure,) no accurate knowledge of the pressure of steam could be ascertained by safety valves as ordinarily used.

These defects are supposed to be entirely avoided in the valve now submitted to your examination.

Its position is the reverse of the ordinary one; that is, instead of opening upwards, it is made to open downwards. For this purpose it is raised above the boiler, and connected to it by a pipe. By this arrangement you will perceive that the pressure requisite to keep the valve closed must be exerted in an upward direction. To attain this, and at the same time *limit* the pressure, a simple device is adopted, which will be understood by supposing an empty vessel (a bucket, for example,) placed with its bottom down, into water, or any other fluid; if depressed in that position, the power required to do so will be in proportion to the area of its bottom and the depth of its immersion; but if forced down till its upper edge becomes level with the surface of the fluid, the power required to keep it there, or in other words, the force which the vessel exerts in a contrary direction, will then be at its maximum; for if further depressed, the fluid would run into and sink it, and destroy its buoyancy altogether.

Suppose the vessel containing the water, which is rather larger in diameter, but of less depth, than the bucket, (that the fluid may never be permitted to run into the latter,) be placed immediately under the safety valve, and firmly secured to that part of it containing the seat of the valve. Let the bucket be placed in it in the position as before; and a rod, extending from the centre of its bottom to the centre of the valve; then, if the outer vessel be filled with water, the force tending to raise the bucket against the valve, by means of the rod, will be as before mentioned, at its maximum; nor can it be increased: consequently, the elastic force of the steam in the boiler can never rise higher than what is equivalent to overcome this pressure.

The length of the rod is such as to admit a space of two or more inches between the bottoms of the two vessels, in order to allow the valve to open that distance.

The foregoing is a brief description of the *principle* adopted in this valve; and which may be more clearly understood by the annexed cuts:

Fig. 2.

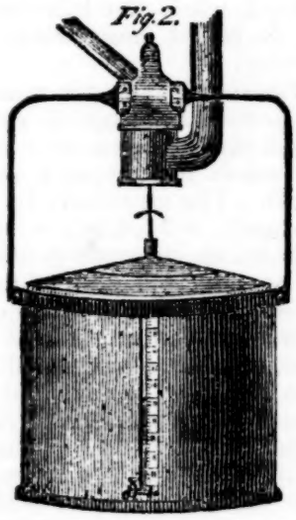


Fig. 1.

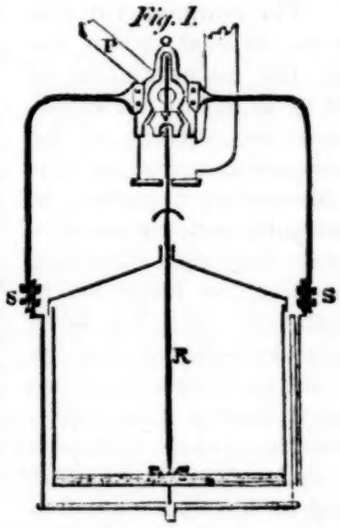


Fig. 1 represents this valve in section with the vessels by which the hydrostatic pressure is made. The outer one is enlarged at the top by a rim, from which a pipe descends, which prevents any surplus fluid from flowing over it or entering the inner one. It is firmly secured to the inverted valve seat by the rectangular rods which are bolted to the rim at S S. V is the valve, kept up against its seat by the rod R, the upper end of which enters a countersunk hole in it; and the lower end in a similar cavity in the centre of the bottom of the vessel. The rod being tapered at its ends, presses only on its central points. The inner or floating vessel is furnished with a cover, to prevent condensed steam from falling into it when the valve is opened. The rod passes through the centre of this cover, a few inches above which an inverted cup is soldered to the rod to cover the opening. A short tube, with a branch attached to it, is connected to the under part of the valve seat, to take off the waste steam when blowing off. The communication between the valve and the steam in the boiler is by means of the pipe P, which may either be connected to the boiler or the steam pipe.

To prevent any friction arising from the inner or floating vessel touching the sides of the other, a short rod is attached to the centre of its bottom on the under side, which enters a corresponding cavity drilled into the bottom of the other.

This apparatus, unlike the ordinary safety valve, combines in itself both the valve and gauge, with its tell-tale ; and this gauge is applicable to steam of *every degree of elastic force.*

Fig. 2. is an exterior view, and which also shows the gauge ; which is a glass tube connected to the cock at the bottom of the outer vessel, and communicating with the water in it. It is open at top, and protected by a metallic case with a slit its whole length, to allow the height of the water to be seen. This case is graduated, so that when it is wished to ascertain the strength of steam, the cock is opened, and the water allowed to subside until the steam begins to open the valve, when the mark on the case, opposite the surface of the fluid in the tube, indicates the pressure ; and this it will do to the fraction of an ounce.

In this valve there is no friction to be overcome. No lever, stuffing box, weight, bolts or joints, to obstruct its operation. *It cannot be overloaded.* The common valve is very liable to adhere to its seat, when not frequently moved, by the accumulation of saline or other matter upon it, but the elevation of this valve above the surface of the boiler, and its inverted position, prevents this from taking place. Moreover, a portion of condensed steam constantly collects above it, and occasionally oozes out, thus cleansing the surface and preventing the formation of any matter upon it whatever. One has been attached to a high-pressure boiler in this city for three years ; and not an hour's labor has been expended upon it during that time ; nor has it once ceased to operate with perfect accuracy—the steam always blowing off as soon and as long as its tension exceeded the prescribed limits.

It is respectfully submitted to owners and captains of steamboats, whether the adoption of this valve would not prevent explosions that arise from *one* acknowledged source—an excess of steam : and at the same time put to silence the complaint of the public on that subject. Very respectfully,

THOS. EWBANK.

P. S.—One of them is at Mr. Worrall's Foundry, Elm Street, New-York.

GLASS TILES.—M. Dorlodot, a glass manufacturer, at Anzin, in France, has invented a species of glass tile, of great solidity and transparency, which, it is thought, may be substituted with much advantage in all cases where skylights are now employed. The existing excise laws of Great Britain oppose, however, an insuperable bar to their adoption in this country, unless under circumstances where expense is no object.

MACHINE FOR EXCAVATING EARTH.—Mr. G. V. Palmer, of Worcester, has been ten years and upwards engaged in constructing an extraordinary engine to excavate earth, &c. for which he has taken out a patent. This engine works by steam, and is particularly adapted for cutting canals, levelling hills for railways, and removing large masses of earth. The engine cuts, at a single blow, six feet in width and three feet in depth—delivering on either side, or into carts, one ton and upwards per minute : it also cuts and sifts gravel in the same proportion for road-making. We understand it is of great simplicity of construction, and the weight of the engine does not exceed three tons.—[Manchester Courier.]

MACHINE FOR MAKING BRICKS.—Messrs. Harkness, Sawyer, and Freelove, have now in successful operation a machine which has excited the admiraton of all who have witnessed its operation. It produces twenty bricks in a minute, and these too, not the unshapely and rough masses of mud, which we usually call bricks, but a square and smooth body of clay, so hard, when they leave the press, that they are fit to set immediately into the kiln for burning.

The moulds (four in number) in which they are pressed are made of polished steel plates—which plates are set in a cast iron box ; and the whole banded with strong wrought iron bands. The machinery is so constructed that the mould is fixed in a solid stationary frame ; and after the pressure is made upon the clay in the mould, the bottom of the mould rises, and throws the brick to the top, so that it may be conveniently taken off. It is found by experience, that not less than 50 tons pressure upon each brick will answer the purpose. This amount of pressure is, of course, wanted only at the very *last* moment of the impression ; or, in other words, can be pressed with very little effort into a space within, say, one-fourth of an inch of the proper thickness. After it is thus far pressed, it then requires at least 50 tons to bring it to a proper degree of density. The machine in question is so constructed as to give this great pressure at the *time it is wanted*, and no other. In fact, it would be difficult to find, in all the mechanical operations now in use, a more perfect adaptation of the *means* to the *end.* And it is thought by many scientific gentlemen, who have examined the matter, that *no other* application of the mechanical powers will ever be made to effect the same object.

It is only necessary that the utility of this machine should be known, in order to introduce it into general use. The beauty and durability which it will impart to the brick buildings of the country must make it an object of great pub-

lic interest. Add to this, the reduction of expense which must ultimately follow, and I cannot but regard the improvement of the gentlemen above named as of equal importance to any which has been introduced for the last 20 years.

The following *practical* statement, which has been obtained from the patentees, will no doubt interest such of your readers as are engaged, or may feel disposed to engage, in brick making.

A brick press can be put in operation for about $6.

The expense of carrying on the business for a month is as follows:

1st. 6 hands at $10 per month, - -	$60.00
Boarding same at $1.25 per week, -	30.00
2d. 3 boys at $6 per month - -	18.00
3d. 2 horses at $7.50 per month, - -	15.00
4th. 60 cords of wood at 90 cts. per cord,	54.00
The setting and burning of 180,000 bricks, at 40 cts. per 1,000, - -	72.00
	$249.00

The above are the regular expenses per month of carrying on a horse-power press. The press, when in operation, makes 20 bricks in a minute, or 9,600 in 8 hours. Deducting, however, for loss of time and other contingencies, 1-4th for every day's work, leaves the amount of 7,500 bricks per day, or 180,000 per month; which, at $3.50 per 1,000, are worth $630. Deduct the expense of making, which is $249, and there remains a clear profit to the owner of $381 per month; or, $1,905 for five months, the time that could be conveniently occupied each season in brick making.

The above estimate is based upon the price of brick, of labor, and of boarding, at Mount Vernon. In many places, labor and boarding would doubtless be more expensive. But in such places, the price of brick would probably be increased in proportion.—X. Y. Mount Vernon, May 15, 1834.—[Ohio State Journal.]

Statistical Facts in relation to the Chesapeake and Ohio Canal. To the Editor of the American Railroad Journal.

WASHINGTON, April 11, 1834.

SIR,—The following statistical facts, in relation to the Chesapeake and Ohio Canal, I have collected from the mass of documents which have been printed by Congress and the Company, and which amount in bulk to several octavo volumes. I have not, either, all of their reports to refer to, as the price of an entire copy of the proceedings of the board of directors and engineers costs now $20 to $25, and many of the papers are very scarce. Such as are given below will, I hope, answer your purpose. Alter them and change them as may best suit your views.

The general convention of Delegates from Pennsylvania, Maryland, Virginia, the District of Columbia, and one or two of the Western States interested, first met at Washington, D. C., in November, 1823, to determine on the proper measures to be adopted in reference to the successful prosecution of this great work of internal improvement. The first charter was granted by Virginia, in January, 1824, which was confirmed by Maryland in January, 1825, and by Congress in March of the same year. Pennsylvania granted her charter with some restrictions, (relative to portions of the appropriations of Congress being applied to the construction of the western section, &c.) in February, 1826. All four of these legislative bodies have since passed various acts, extending and restricting the powers of the Company.

SUBSCRIPTIONS.—Books were opened in 1826, after the confirmation of the charter by the several states.

Private subscriptions, - - -	$610,000
By Maryland, in March, 1826, -	500,000

Maryland, in 1834, granted $50,000 additional: $25,000 cash, and the remainder when a further subscription was made by Congress.

By Virginia, in 1833, - - -	250,000

Virginia had subscribed, in 1826, her interest in the Potomac Canal Company, which was then valued at 2 or $300,000.

By Corporation of Washington, -	1,000,000
By Corporation of Alexandria, -	250,000
By Corporation of Georgetown, -	250,000
By Congress, - - - -	1,000,000

The cost, as estimated by the U. S. Engineers on the first surveys, was $22,375,427.69; and, by Geddes and Roberts, the company's engineers, since that time, was $9,347,408.69.

The projected route, (and in its location, thus far, it has deviated very little from the line originally laid out,) was up the valley of the Potomac river, as far as Cumberland; thence it follows the valley of Wills' creek, as far up as the mouth of Bowman's run, from which place it is to cross the summit ridge by a tunnel, railway, or inclined planes, as the company may see fit, the privilege of selecting being granted by their charter. (It is most probable that the company will adopt a railway with stationary power, as it will in the end prove the cheapest and most convenient.) The western course is thence down Castleman's river and the Youghagany, and the Monongahela, to Pittsburg. (It is doubtful, I think, whether this line, the western section, will be adopted, as the United States have been projecting improvements on the Monongahela river, so as to render it navigable as far as Brownsville, 55 miles by the course of the river above Pittsburg, and it will be shorter and more convenient to end at Brownsville than its present projected termination.) The total length of this projected route is 341 miles 676 yards, and is divided into the eastern, the middle or mountain, and the western sections, the former extending from Georgetown to Cumberland, 185 miles 1078 yards; the middle section, thence to the mouth of Castleman's river, 70 miles 1,010 yards; and the latter thence to Pittsburg, 85 miles 348 yards.

DIMENSIONS OF THE CANAL.—The size of the Erie canal was at first adopted as sufficient for the Chesapeake and Ohio Canal.

this idea was soon abandoned, and the following size determined on: 60 feet wide at surface, 42 feet at bottom, and 6 feet deep, giving a cross section of 366 feet. But for the purpose of giving sufficient water for manufacturing purposes, the first two miles above Georgetown were widened to 70 feet, with a depth of 7 feet, and the succeeding two miles have a width of 80 feet, and 7 feet depth. Between Harper's Ferry and the Point of Rocks, in some few places, and for short distances, it has been narrowed to 50 feet, and above Harper's Ferry it has been widened to 90, 100, 120, and even 150 feet, in several places. The locks are 100 feet long by 15 wide, in the chamber, and 6 feet deep. The tow paths are 12 feet wide, and the berm bank 8 feet. All the culverts, aqueducts, and locks, are built of solid stone masonry, laid in hydraulic lime. Many of the locks are so constructed, by lengthening the side culverts and multiplying their outlets, as to be filled in one half the usual time.

In November, 1830, the sections extending from the Seneca feeder to the termination of the old canal, around the Little Falls of the Potomac, (a distance of 17 miles and 774 yards,) were finished and opened for use. The sections in Georgetown were finished in August, 1831. The sections from the Seneca feeder to the Point of Rocks, (a distance of 26 miles and 363 yards,) were open for use in the spring of 1832, and by the end of 1833 it was completed as far as Shepherdstown, (72½ miles from Rock Creek Basin, Georgetown.)

Between the Georgetown Basin and the Point of Rocks, a distance of 48 miles 118 yards, is a rise of 217 feet, overcome by 27 locks: for the lift and distribution of which see table given below. Between the Point of Rocks and Williamsport, (to which the canal will be open from Shepherdstown this spring or summer,) a distance of 66 miles and 762 yards, is a rise of 136 feet, overcome by 17 locks: see table.

No. of lock.	*Lift.*	*Construction.*	*Distance from lock to lock.*	*Total distance frm tide lock.*	*Remarks.*
	at l. wat.		m. yds.	m. yds.	
Tide l.	3 ft.	Cut stone. Free stone.			In the locks of 8 feet lift, there are about 1,084 perches of masonry; each 4,426 superficial feet of ashlar (excluding coping and hollow quoins); 436 lineal feet of coping, 1 foot thick by 3 feet wide, making 4 feet of cut work for evry foot lineal; and 61⅔ feet rise of hollow quoins: where the cut stone are exactly of the size required by the specifications, there are 384 perches of cut stone and 700 perches of backing. The quantity of cement for each lock of 8 feet lift, has varied from 3,000 to 3,300 bushels.
No. 1	8	Same as tide lock.	661	601	
2	8	Same.	81½	742½	
3	8	Same.	100½	843	
4	8	Same.	98	941	
5	8	Partly of hammered and partly of cut stone.	4 909	5 90	
6	8	Same. Free stone.	637	5 727	
7	8	Cut, granite, and free stone.	1 1075	7 42	
8	8	Red sand stone. Cut	1 594	8 636	
9	8	Granite and free stone. Cut.	604	8 1240	
10	8	Cut stone. Granite.	153	8 1393	
11	8	Cut. Red sand stone.	319	8 1712	
12	8	Cut stone. Granite.	545	9 497	
13	8	Same.	148	9 645	
14	8	Granite. Cut.	148	9 793	
15	8	Red sand stone. Cut.	3 1740	13 773	
16	8	Same.	311	13 1084	
17	8	Same.	618	13 1702	
18	8	Same.	178	14 120	
19	8	Same.	134	14 252	
20	8	Same.	198	14 452	
21	8	Same.	2 623	16 1075	
22	7	Same.	2 1544	19 859	
23	8½	Same.	2 856	21 1715	
24	8½	Same.	1174	22 1129	The masonry of lock No. 24 is connected with the lower abutment of the Seneca aqueduct.
25	8	Same.	8 23	30 1152	
26	8	Same.	8 1137	39 529	
27	8	Same.	2 20	41 549	From lock No. 27 to the Monocacy aqueduct is 1,156 yards—the aqueduct, 172 yards long—thence to the Pivot bridge at the Point of Rocks is 6 miles 1 yard.
				48 118	
28	6	Granite transported on Balt. & O. Railroad, and flint (hard white) stone from neighborhood. Cut stone.	1337	48 1415	
29	7	⅔ Balt. granite. ⅓ hard white flint. Cut.	1 1597	50 1292	
30	8	Patapsco granite 1-7 & red sand stone. Cut.	4 143	54 1435	
31	8	Granite and flint from neighborhood.	3 121	57 1556	The foot of lock No. 33 is connected with the abutment of the bridge over the Potomac at Harper's Ferry.
32	8	Granite & lime stone from neighborh. Cut.	2 332	60 128	
33	8	Lime stone. Cut work.	760	60 888	
34	8	Same.	1556	61 684	The cost of lock No. 35, as well as that of 36, 37, 38, 39, 40, 43 and 44, (8 in number,) was at the rate of $1,120 per foot lift. This was including gates and foundations.
35	8	Same.	1267	62 191	
36	8	Same.	173	62 364	
37	9	Same.	4 909	66 1273	
38	5	Same.	5 1426	72 969	The two locks, Nos. 41 and 42, are constructed of Lawrence dressed lime stone; were built for $800 per foot lift, including gates and foundations.
39	6	Same.	1 287	73 1226	
40	9	Same.	6 447	85 940	
41	10	Hammered stone Lime stone.	6 1740	92 920	
42	9	Same.	200	92 1120	
43	9	Lime stone. 3 miles transported. Cut stone.	200	92 1320	Total lockage, 353 feet, from the Georgetown basin.
44	10	Same.	6 1020	99 580	

Besides the above 44 lift locks, a communication with the river Potomac is to be effected through the guard locks at the entrance of the feeders from the Potomac, and also through the several lift locks designed for the Virginia trade, and constructed in compliance with the Virginia charter. Four of these locks are required to be constructed similar in size and construction to the other lift locks of the canal, viz.: one opposite the mouth of Goose creek, which enters the Potomac, opposite the foot of lock No. 25; another at the Point of Rocks; ano-

ther opposite Shepherdstown; and the 4th, near the mouth of Opequon. The latter has since, however, been dispensed with, as its purposes are subserved by the transfer of locks Nos. 41 and 42, (which were located 2 miles above the mouth of Opequon,) to 2 miles below the mouth of that river. This transfer reduced the slack water navigation, between guard lock No. 3 and lift lock No. 41, from 7 to 3 miles, and increased the expense $100,000. There is also a lift lock in addition to the above constructed, connecting with the Potomac opposite the junction of the Shenandoah with the Potomac at Harper's Ferry, 637 yards above lock No 32. It has 10 feet lift, and is, in other respects, similar to the other locks.

Culverts.—Below the Point of Rocks there are, inclusive of roadways, 59 culverts, of which the total cost was $110,000. Three of these culverts are of 12 feet span each, 2 of 16 feet span each, (one over the Tuscarora, 2 miles above the Monocacy aqueduct, and the other 1 mile below the Point of Rocks,) and 1 of 2 arches of 16 feet span each over the Little Monocacy river: the total number of perches of masonry in these 59 culverts amounts to ——, costing $51,872—32 culverts, nearest Point of Rocks, 11,357, $50,000. Between the Point of Rocks and Harper's Ferry the number of culverts is 19, containing in all 6,839 perches of masonry, and the total span of which was 158 feet. There are, also, above Harper's Ferry, 41 culverts, the estimated price of which was $44,300. The culverts below Harper's Ferry are generally 110 feet long; while above, owing to the contraction in the width of the canal, they do not exceed 100 feet.

Aqueducts.—No. 1. Seneca aqueduct, built of red sand stone from the immediate neighborhood, is 114 feet long between the abutments, which, with the 2 piers, rest on a solid foundation. There are 3 arches of 33 feet each. Cost $22,784.

Aqueduct No. 2. Monocacy aqueduct, built of a white granite stone, (obtained within 3 miles of the site of the aqueduct,) is 438 feet in length between the abutments, and is 516 feet from end to end of the wing walls which project from them. There are 7 arches of 54 feet span each, and 9 feet rise, (segments of circles,) the radius of intradoes of which is 45 feet. It contains 9,788 perches of masonry, (exclusive of the rough walls in which the cut masonry of the wings terminates.) Cost, $125,000.

Aqueduct No. 3 crosses the Catoclin, a tributary to the Potomac; it has 3 arches, 2 semicircular, of 20 feet span each, and the third a semi-ellipse of 40 feet span and 10 feet rise, supported on piers, 6 feet wide by 33 feet long, while the parts under water (7 ft. in depth,) are 8 by 35, founded on solid rock. Cost, $33,500.

Aqueduct No. 4 is over the Antietam, a branch of the Potomac, entering 3 miles above the Government dam above Harper's Ferry. The abutments are 9 feet thick, and 108 feet apart. It has 3 semi-elliptical arches, 2 of 28 feet span, and the 3d of 40 feet span, with a rise of 10 feet each. The foundations of the piers and abutments are on solid rock. Greater portions of them are of cut stone masonry and expensively built. Lime stone from the neighborhood used. The towing path parapet is 7 feet thick at bottom and 6 at top. The berm parapet is 5 feet thick at bottom, and 4 at top. Width of track is 20 feet at bottom and 22 at top. Cost, $22,850.

Aqueduct No. 5 is over the Conococheague, which enters the Potomac at Williamsport. It has 3 arches of 60 feet span each; two piers and two abutments. The piers are 12 feet thick at the base. The arches are 32 feet wide and 15 feet rise. Tow-path parapet, 7 feet thick at bottom, 6½ at top; berm parapet, 5 feet thick at bottom, 4½ at top. The walls are raised 7 feet above the bottom of the canal. Estimated cost, $40,260. Not quite finished in December last.

Feeders.—No. 1. The Little Falls feeder supplies 4⅔ miles of canal. An arched stone dam is thrown across the Potomac, and the admission of water into the canal is regulated by a single guard gate, and enters at the foot of lock No. 5. Length of the dam, 1750 feet, height 4 feet. Cost ———. The feeder is a part of the old canal around the Little Falls, constructed previous to 1800.

No. 2. The Seneca feeder supplies 17 miles, although at the foot of lock No. 18, at the Great Falls, an additional supply is received from the Potomac, through a small arch under the towing path. The dam across the Potomac for this feeder is — feet high, and 25,000 feet in length, and cost ———. The water is admitted into the canal through guard lock No. 1. The dam is of stone and arched.

No. 3. The canal for the next 40 miles depends almost entirely for water on the supply it receives from the Potomac at the head of Harper's Ferry Falls. The dam constructed by the Government for the use of the United States armory at Harper's Ferry answers all necessary purposes here, and no more water is drawn off than was formerly used by the old canal, which has been closed since the opening of the main canal. (A small feeder from the Tuscarora, which enters the canal 17 miles below the head of Harper's Ferry Falls, also assists towards supplying this section.) The water from the Harper's Ferry feeder is admitted through guard lock No. 2, situated near lift lock No. 35. This dam is — feet high, and — feet long. Cost of company's works here ——.

No. 4 supplies 23½ miles of canal. The dam across the Potomac is near ————, and is 20 feet high, and 810 feet long, and 60 feet base. The water is admitted into the canal through guard lock No. 3, which is 1 mile 320 yards above the dam. Cost of dam, lock, and other works connected with the feeder, ———.

No. 5 feeds 19 miles of canal, and is situated 8 miles above Williamsport. The dam across the Potomac is at ————, and is 20 feet high, 706 feet long, and 20 feet base. The water is admitted through guard lock No. 4, 320 yards above the dam. Cost ———.

Some facts I have not here been able to find out, but which I hope you will be able to obtain, should they be of any service.

Costs.—The following work, done between the Point of Rocks and the Georgetown Basin:—Common excavation, 1,893,666 cubic yards; Hard pan do., 439,071 do.; Quarry rock do., 75,472 do.; Rock blasted, 398,524 do.; Embankment, 1,533,850 do.; Puddling, 96,092 do.; Walling, 231,064 cubic perches. Costing $1,032,161; for grubbing, $12,892; extras, $40,800.

Extra on this section:—Pier, basin, and tide lock, at Georgetown, $78,943; Locks, $232,642; Lockhouses, $16,315; Bridges, $32,925; Aqueducts, $23,444; Culverts, $51,872; Waste weirs, $8,619; Dams, $30,491; Guard locks and feeders, $15,404; Improvements, $22,002.

The masonry on the dams, locks, aqueducts, pay for engineers, officers of the company, &c. are not included in the above. Items given separate.

Work done and to be done from the Point of Rocks to Williamsport—all under contract, and a great portion finished:—Common excavation, 2,733,905 cubic yards; Rock do., 433,752 do.; Slate do., 8,140 do.; Embankment, 1,350,149 do.; Puddling, 37,617 do.; Walling Stone, 181,029 cubic perches. Actual and estimated cost of the above, $936,735.74; for grubbing, $9,653; extras, $8,564.13. Total, $954,952.87, besides the masonry on locks, aqueducts, culverts, bridges, &c. &c.

I have not been able to obtain a full aggregate amount of the expenditures of the company, nor an actual statement of the entire cost of the canal. It has had to meet enormous law expenses on account of its difficulties with the Baltimore and Ohio Railroad Company; besides being subjected to very large losses in the delay occasioned by the injunction of the Chancellor of Maryland in the above case. The right of passage, too, over the various lands of private individuals has cost immense sums.

The pass at the Point of Rocks, held in dispute between the two companies, was $11,153 feet long, or $2\frac{1}{10}$ miles. The distance from Harper's Ferry to Cumberland, according to Geddes and Roberts' report, is 127 miles, and the amount of all the narrow passes where the works would come in collision would amount in all to 45 miles.

The reports of the united engineers, who have been at various times invited by the company to inspect the different portions of the work, are all declaratory of the perfect and substantial manner in which the work has been constructed throughout. These reports, have been called for by Congress, and, on being submitted, have been ordered to be printed. They contain a great deal of information relative to this grand work, and are worthy of perusal. This spring, notwithstanding the many delays and difficulties of the most arduous and imposing nature the company have had to contend with, will see the canal opened some distance above Williamsport, a distance of 102 miles of canal, and $14\frac{1}{2}$ slack water navigation, fully complying with the charter, which required upwards of 100 miles to be completed within 5 years from its commencement, or rather from October, 1828. Some report I have just got hold of, says the entire cost of this construction was $3,650,000, of which $450,000 was expended from Little Falls down.

I can add that the prospects of the canal are truly encouraging. Having command of an extensive coal region, and passing through a highly cultivated valley, where there are also numerous grist and other mills, and abundant mineral resources, besides the coal, they can never be at a loss for means of rendering the canal profitable. They cannot experience much competition, either from the Baltimore and Ohio Railroad, on account of the heavy weight of the produce to be conveyed, and cheapness of conveyance on the canal. The Washington City branch of the Chesapeake and Ohio Canal extends from the Rock Creek basin on the western borders of the city to the mouth of Tiber creek, following the bend of the river Potomac, (being constructed along the bank of that river, and in some few places encroaching on the river itself,) a distance of 1 mile and 373 yards. A tide lock at the eastern termination brings it to the level of the Potomac. The cost of this branch was $25,978.47.

Very little has yet been done on the Alexandria branch of the canal. Congress has made an appropriation of $60,000, I believe, for the construction of an aqueduct at Georgetown, across the Potomac, for the transfer of the canal to the Virginia shore. The length of this branch is 7 miles and 416 yards, and the estimated cost $372,204.55. The aqueduct has been contracted for some time since, and is now in progress of construction under the superintendence of Capt. Turnbull, U. S. topographical engineer. It is 1714 feet long; the canal way is to be 16 feet wide at bottom, 18 feet at top, and 5 feet deep, and thence, to Four Mile run, the size of the canal is to be 32 feet wide at bottom, 50 feet at top, and 6 feet deep. At the embankment, at Four Mile run, it is to be 18 feet wide at bottom, 36 feet at surface, and 6 feet deep. Thence to Alexandria it is to be enlarged to the established dimensions of the Chesapeake and Ohio Canal.

H. N. C.

City of Washington, May 27, 1834.

To the Editor of the Railroad Journal:

Sir,—I forwarded, some time since, by a private conveyance, an answer to your letter asking for information relative to the Chesapeake and Ohio Canal, which gave you such statistical information respecting that grand work as I could collect. I am not aware that it has yet reached you, though it has been nearly a month, if not more, since I wrote it. I could not then get a copy of the rate of tolls demanded on the canal, but having since succeeded, I forward them to you. This rate is only temporarily established, and it is probable, ere long, that a more favorable change will take place. Should you determine on publishing the inclosed, you will be pleased to notice the fact that this arrangement in respect to the tolls is only temporary.

Articles.	*Quantities.*	*Per mile for first 15 miles.*	*Per mile over 15 miles.*
Tobacco, - - - -	per ton of 2 hhds.	2 cents	2 cents
Wheat, - - - - -	" 40 bushls	2	2
Flour, - - - - -	" 10 bbls.	2	2
Offals, - - - - -	" 100 bshls	2	2
Corn Meal & Rye chop,	" 40 "	2	2
Oats, - - - - -	" 80 "	2	2
Flax and Clover Seeds,	" 40 "	2	2
Hemp and Flax, - -	" 2240 lbs.	2	2
Potatoes, - - - -	" 35 bushls	2	2
Hay and Straw, - -	" 2240 lbs.	2	1
Wood, - - - - -	per cord of 128 c. ft.	2	½
Bark (Tanner's), - -	" " "	3	1
Lumber, Plank, -	per 1000 ft. bd. mea.		
" Square timber	70 cubic feet		
" Shingles, -	3000		1 cent,
" Laths, - -	5000		or if in
" Barrel Staves	1000	2	rafts 2
" and Headings,			cents
" Hhd. Staves	500		
" and Headings,			
Charcoal and Coke, -	per ton of 56 bushls	2	1 cent
Coal, - - - - -	" 28 "	1	½
Apples, - - - -	" 12 bbls.	2	2
Cider, Ale, and Beer, -	" 8 "	2	2
Whiskey and Pork,	" 7 barrels or 2 hhds.	2	2
Wine & Foreign Spirits	per tun of 250 galls.	2	2
Live Stock, Cattle, -	4 to the ton	2	2
" Sheep, -	30 "	2	2
" Hogs, -	15 "	2	2
Lime, - - - - -	per ton of 28 bushls	2	1
Plaster, Stone, - -	" 2240 lbs	2	1
" Ground, - -	" 28 bushls		
Stone, Rough, - -	per ton of 15 cub. ft.	1	½
" Cut or Wrought,	" " "	2	2
Grind and Mill Stones,	" " "	2	2
Iron, Pig, Castings, and Bars,	per ton of 2240 lbs.	2	2
Salt, - - - - -	" 35 bushls	2	2
Fish, - - - - -	" 7 barrels	2	1
All other articles, -	" 2240 lbs.	2	2

Boats or scows, either empty or having cargoes, the tolls on which shall not pay 5 cents per mile, shall be charged at the rate of 5 cents per mile, and 3 cents per mile for any additional distance, which shall be considered as in lieu of the tolls on such cargoes.

Boats used chiefly for the transportation of passengers shall pay 10 cents per mile for the first 15 miles, and 8 cents per mile for any additional distance, which shall include the toll on passengers and their customary baggage; but all other merchandize transported therein shall pay the established rate of toll.

The above rates are established for the present for the use of the canal between the city of Washington and Harper's Ferry Falls; and the same rates per mile will be demanded for the use of any portion of the river between the Little Falls and the Harper's Ferry Falls; for the use of the river above Harper's Ferry Falls, the tolls established by the late Potomac Company will be demanded.

The canal is now in active operation, and will soon, I believe, be opened for several miles above Williamsport, where the slack water navigation of the Potomac is used, (for a distance, I think, of upwards of 7 miles,) making in all a distance, from the Georgetown basin, of upwards of 110 miles.

I should like you to have a copy of Dr. Wm. Howard's report on the improvement of the Monongahela river, which is, at present, a favorite project in the western part of Pennsylvania, and one which, if executed, will tend as much as any other work of internal improvement to add to the resources of that region of country, so rich in mineral and agricultural products, and where the arts have attained such perfection. Your obedient servant,

H. N. C.

To John O. N. Rutter, *Wine Merchant, for his Invention of an improved Process for generating Heat, applicable to the heating of Boilers and Retorts, and to other purposes for which Heat is required. Sealed March* 30, 1833.

The subject of this patent is the employment of bituminous, resinous, or oily matters, in connection with water as a combustible material, which, it is said, will produce a fuel for furnaces, boilers, &c. capable of giving out a very intense heat. Strange as the suggestion of applying water as a combustible material may appear, it is reported to have been found extremely advantageous, economical, and convenient. We of our own knowledge can say nothing upon the subject, but merely give the patentee's views and recommendations in reference to the manner in which he proposes to employ those materials for the production of heat.

Bituminous, oleaginous, resinous, waxy, or fatty substances, are to be employed: as coal tar, which is to be combined with water in certain proportions. It is proposed that a stream of coal tar shall be allowed to flow from a reservoir through a pipe with a stop-cock, and likewise a stream of water from another reservoir through a similar pipe; that the two streams shall meet, and fall into one general receiver with a funnel tube, by which they may be together delivered into the furnace.

The proportions are recommended to be one gallon of coal tar to one gallon and a half of water, the flow of the two liquors to be regulated by suitable apertures or stop-cock. These quantities of materials are to be slowly discharged from the funnels, that the whole shall occupy from two to three hours in its delivery into the furnace; and where the furnace is of such magnitude as to require it, several of these funnel tubes may be employed, each delivering its supply of materials in the proportions and times stated.

It is not necessary to use water in a pure state, to be mixed with the coal tar, as foul water will answer the purpose equally well; and on ship-board, where the invention may be usefully applied to steam navigation, the bilge-water from below, or sea-water, may be pumped up and employed for the purpose, and on land the ammoniacal liquor from gas works will also suit as well as fresh water.—[London Journal.]

NEW INVENTION.—A blacksmith in Virginia has invented a machine for striking, which enables blacksmiths to dispense with a striker, and at the same time perform, with the aid of one of these machines, double the amount of work which they can with the aid of one of the best strikers. The machine is propelled by the foot in the ordinary manner of turning a lathe. The inventor has secured a patent right.

NATURALIZATION OF FISHES.—At a late meeting of the Zoological Society, were read two letters from Mr. J. B. Arnold of Guernsey, detailing his experiments in the naturalization of sea fishes in a lake chiefly supplied with fresh water. The area of the lake is about five acres; its depth various; and its bottom also various, being muddy, gravelly, and rocky. The water is, during nine months of the year, drinkable for cattle, but in consequence of a supply which it receives through a tunnel communicating with the sea, is rather salt in summer, at which season the fishes do not come down so plentifully as at other times. The fishes introduced into the lake have been the grey mullet, sole, turbot, brill, plaice, basse, smelt, and grey loach. All of these have thriven well, and are believed to have increased in numbers; the grey mullet especially is known to have bred as freely as in the sea itself. A single whiting having been caught for three successive years, was found to have grown considerably; a pilchard also throve well. All the above-mentioned fishes were placed in the lake, except perhaps the brill; but others, as the silver bream, appear to have introduced themselves. It is even suspected that hybrid fishes have been produced, as several have been caught which were unknown to persons well acquainted with the species usually met with on the coast of Guernsey. Mr. Arnold adds that sea fishes, after having been naturalized in his lake, have been transferred to ponds of spring water, where they have not only lived, but done well; and that such naturalized fishes have been carried to a long distance, being much more tenacious of life than those caught in the sea.—[Proc. Zool. Society.]

QUIETUDE.—Happy, indeed, would be the condition of mankind, were all disposed to cultivate that harmony and friendship so desirable and necessary to the welfare and prosperity of society—the world would be similar to a paradise, and the people, if not angels, would approach the character ascribed to them—mankind, as they ought to be considered, would present a band of brothers, happy, quiet and content. Our citizens, from the highest to the lowest, would be satisfied with their respective stations, and the agitation which now pervades society would rest in quiet and repose.

If there is any quiet on earth, the farmer may be said to enjoy it: with a competence in store, the honest fruits of his industry, he thrives secure from the turmoils of those who pursue other avocations for subsistence. The mechanic, the professional man, and all who support themselves by speculative measures, must expect to contend against the current of disappointment, and prop their sinking hopes by anticipating future prospects; and although their situation may appear enviable to the unscrutinizing eye, on the contrary, they have abundant reason to envy those who live on the fat of the land, enjoying the bounties dealt out by Nature with a liberal hand.

THE FOOL HATH SAID IN HIS HEART, THERE IS NO GOD.

There is no God, the fool hath said,
With proud pretensions high.
There is no God? Who hath then made
The earth, the sea, the sky?

Who made those glorious orbs of light
That in their orbits run?
"The moon and stars to rule the night,—
To rule the day, the sun?"

Who drew the plan for all these spheres?
Who moulded, gave them form?
Who guides the comet that careers
Through space? Who rules the storm?

Who gave these motion, round to roll,
And poised them in their course?
And who has fixed their central pole,
And centrifugal force?

All nicely weighed, and balanced all,
To keep exact their course.
Who peopled this terrestr al ball—
Did chance exert this force?

Chance make an insect, plant, or flower,
And give it life, and laws!
Let chance again put forth this power,
If that's the great first cause!

Intelligence and power combined,
To form the creature man;
The vast machine, the active mind,
None but a God could plan.

Wisdom and power, and goodness, shines
In all things, great and small,
And perfect skill the whole combines,
And GOD is seen in all.

There's not a plant on earth that grows,
There's not a single flower,
But what his skill and goodness shows
His all-pervading power.

The shape, the taste, the color, smell,
Are fixed by wisdom's laws,
And natures too minute to tell,
Known to the GREAT FIRST CAUSE.

Each kind diverse, its own the same,
The seed, the plant, the fruit,
All their Creator's skill proclaim,
'Tis GOD, beyond dispute.

Go, sceptic. and true wisdom learn,
————'s lectures hear.
No more the great Creator spurn,
When GOD shines out so clear!

In every animated thing,
The stamp of *God* we find,
Conviction to the heart they bring
Of UNCREATED MIND.

There is a GOD—all things declare,
Most holy, just, and wise;
Creation is his temple fair,
His palace is the skies.

THE *Mechanics' Magazine and Register of Inventions and Improvements* is published by the Proprietors, D. K. MINOR and J. E. CHALLIS, at No. 35 Wall street, New-York: in *weekly* sheets of 16 pages, at 6¼ cents—in monthly parts of 64 pages, at 31¼ cents—in volumes of 384 pages, in cloth boards, at $1.75—or at $3 per annum, *in advance*.—JOHN KNIGHT, (formerly proprietor of the London Mechanics' Magazine,) Editor.